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## Value Stream Mapping as a Tool for Lean Implementation: A Case Study

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### **Abstract:**

*The main purpose of the paper is to know how value stream mapping(VSM) is a powerful tool in lean implementation and to tackle the improvement areas from the current state & to propose the future state which helps in reducing the lead time, manufacturing cost and delivery in time without compromising for the quality of the product. VSM helps firms to understand and to improve continuously to work towards becoming lean enterprise. A case study was carried out in XYZ manufacturing company in Bangalore and comparison was made between current state and future state where the opportunity was identified for improvements.*

**Key words:** Lean manufacturing, Value stream mapping (VSM), Takt time, Current state, Future state, Work in process, Lead time

### **1. Introduction**

In this competitive world, manufacturing companies has to look at redefining and redesigning of their production systems to attack the competitiveness demanded by the markets [1]. Therefore it is essential to have tools which help in redesign manufacturing process [2]. In this scenario, developed and presented value stream mapping tool as a practical method for redesigning the production systems [3].The main aim of lean manufacturing is to reduce waste, time to delivery, produce the quality products with economical and efficient manner with response to customer demand. The organizations which are practicing lean manufacturing have quality & cost advantages compared to the organizations that are still using traditional production.

The VSM process is straight forward and simple. It always starts at customer demand and work back through documenting all the process and collecting data which is required for manufacturing of a product. It shows the map “Value stream” containing all the data such as work in process, cycle time, lead time, number of equipment’s, operators. Documenting relationship between the controls used to manage the manufacturing process is very important in VSM. Unlike other mapping techniques that only map product flow, VSM documents material & information flow.

### **2. Literature review**

Tools such as visual control, single-piece flow, Kaizen, Poka yoke, Standard WIP, Cellular manufacturing, 5s, scrap reduction to reduce manufacturing waste are used in Lean manufacturing. To become lean enterprise VSM is the best tool [6].VSM is defined as a power ful tool that guides in improvements but also highlights communication and transactional mismatches, inefficiencies in process [3].Value stream is the collection of value added and non-value added activities that provides graphical view of the elements in a process which customer is willing to pay. VSM is defined as “the simple process of directly observing the flows of information and materials as they now occur, summarizing them visually, and then envisioning a future state with much better performance” [8,9]. An attempt has been made to expand VSM for entire supply chain by [14].From VSM an attempt made to develop lean logistics strategy by [15]. A successful approach had made to use VSM as a lean tool to achieve improvement in productivity in automotive industry by [10, 16 and 17].Many researchers contributed for improvement of the supply chain process in an organization using VSM. New value stream tools are emerging due to growing of complexity in manufacturing.Many tools in lean manufacturing have been developed and are in process to support value stream [10, 11, 12, and 13]. Table 1 shows the major contributions in VSM.

Major contributors	Area of work
• Monden (1993)	• Defined value from customers' viewpoint
• Jessop and Jones (1995)	• Developed tools to understand different value streams and their overlapping nature
• Hines et al. (1998); Hines (1999); Grewal and Sareen (2006); Grewal and Singh (2006)	• Identification and elimination of muda
• Brunt (2000); Abdulmalek and Rajgopal (2007); Seth et al. (2008); McDonald et al. (2002)	• Improved productivity of process industry
• Emiliani and Stec (2004)	• Leadership development
• Mcmanus and Millard (2002)	• Product development (PD)
• Seth and Gupta (2005)	• Productivity improvement at supplier end
• Snyder et al. (2005)	• Health care center
• Seth et al. (2008)	• Address various wastes in the supply chain of the edible cottonseed oil industry
• Faisal et al. (2006)	• Mapped supply chains on these two dimensions risk and customers satisfaction
• Klotz et al. (2008)	• Explained impact of process mapping on transparency in an employee training session
• Lasa et al. (2008)	• VSM is a valuable tool for redesigning the productive systems

Table 1: Major contributions to the field of VSM

### 3. Current State Map

The present work is carried out in XYZ manufacturing company in Bangalore for a particular product. The current state map is done with paper and pencil using different VSM symbols to represent pictorial view of information and material flow as product move through production line. Mapping is done based on lean manufacturing principles which are backbone of VSM [16]. All the data required for mapping current state is collected by taking walk across the production line, consulting employees, supervisors and managers. Fig 1 shows the current state map of an assembly line.

The demand per week of product is 50. Number of working days per week is 5.5 days. Shifts per day are 3 and working hours per shift is 6.23 hours.

$$\begin{aligned} \text{Takt time} &= \frac{\text{Available time per shift}}{\text{Customer demand}} \\ &= \frac{6.23 * 3 * 5.5}{50} \\ &= 2.05 \text{hrs} \end{aligned}$$

Demand comes from customer to planning team & the material required for manufacturing of products is sent to supplier through electronic media. Production planning is done based on customer demand by production team. The different process in assembly line is shown in current state map. Data box in map shows cycle time, Takt time, number of operators, number of equipment and number of shifts. It provides information of inventory in between the process which is shown in triangle symbol. The bottom of the map shows the time line consisting of value added and the lead time. The current state map is existing state of the assembly line and helps in identifying problems which will be helpful in improvement of the current state.

### 4. Current State Analysis

Data required for analysis of current state of the assembly line are obtained from the VSM of current state from figure 1. The processing time or value adding time is 16.93 Hrs and production lead time is 63.82 Hrs, an inventory of 31 units as shown in figure 1. There is great opportunity to reduce lead time, process inventory, to maintain a standard WIP (SWIP) and single piece flow.

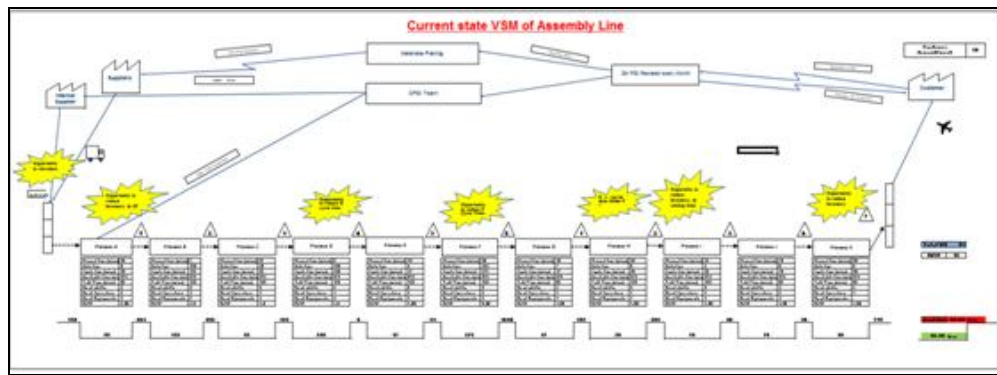


Figure 1: Current state VSM

**5. Future State Map**

After analyzing the current state, improvement areas are identified using kaizen bursts which will lead to reduce process time as shown in Figure 2. The water spider was asked to change from shift wise supply of material to supply based on hourly demand. It was always a push system where the worker at Process A has to wait for material must be replaced by pull system to reduce the inventory, to reduce waiting time and to maintain single piece flow with the help of Kanban system. To synchronize Takt time with cycle time the layout has to be changed, some activities should be eliminated which will not add value to the process by implementing Kaizens. In Process A the cycle time can be reduced from 93minutes to 67 minutes with the help of changing nonlinear work station to conveyor work station. The proposed future state is shown in figure 3.

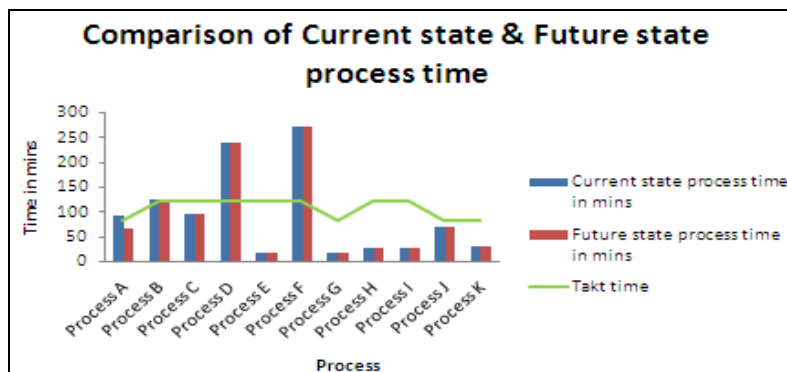


Figure 2: Comparison between Current state and Future state Process time

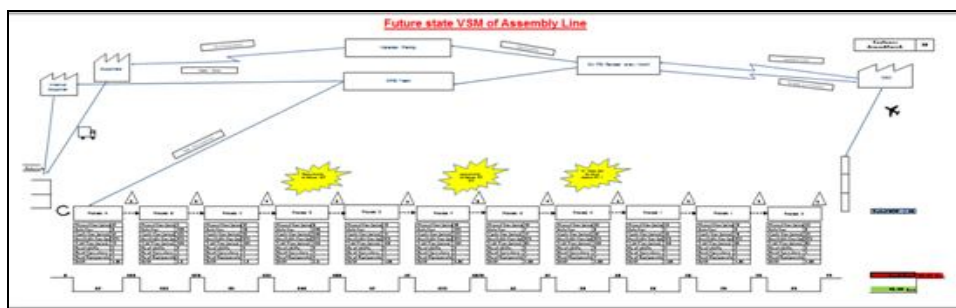


Figure 3: Proposed Future state VSM

**6. Future State Analysis**

From Figure 4 it can be seen that the process inventory is reduced from 31 to 16 units. The lead time is reduced from 63.82Hrs to 39.43 Hrs, process time from 16.93Hrs to 16.48Hrs. The comparison of current lead time & future lead time and current inventory & future inventory is shown in figure 5 and 6 respectively. By implementing this proposed future state the high demand can be met as well as it leads to significant changes in reducing the cost at XYZ Company which will be in position to delivery at without comprising in quality & at lower production cost. When process layout is changed from nonlinear to conveyor system layout and by implementing Kaizens the Takt time can be synchronized with cycle time at Process A. The other improvements shown in figure 3 can be taken on priority depending on the requirements.

Process	Current state lead time in mins	Future state lead time in mins	Current state process time in mins	Future state process time in mins	Takt time	Current Inventory level	Future Inventory level
Process A	811	134	93	67	82	7	2
Process B	495	370	125	125	123	3	2
Process C	125	125	95	95	123	1	1
Process D	0	480	240	240	123	0	2
Process E	51	17	17	17	123	3	1
Process F	1640	1070	275	275	123	5	3
Process G	197	17	17	17	82	1	1
Process H	204	28	28	28	123	3	1
Process I	86	26	26	26	123	1	1
Process J	10	70	70	70	82	0	1
Process K	210	29	30	29	82	7	1
<b>Total</b>	<b>3829.00</b>	<b>2366.00</b>	<b>1016.00</b>	<b>989.00</b>		<b>31.00</b>	<b>16.00</b>
<b>Total in hours</b>	<b>63.82</b>	<b>39.43</b>	<b>16.93</b>	<b>16.48</b>			

Figure 4: Comparison between Current state and Future state

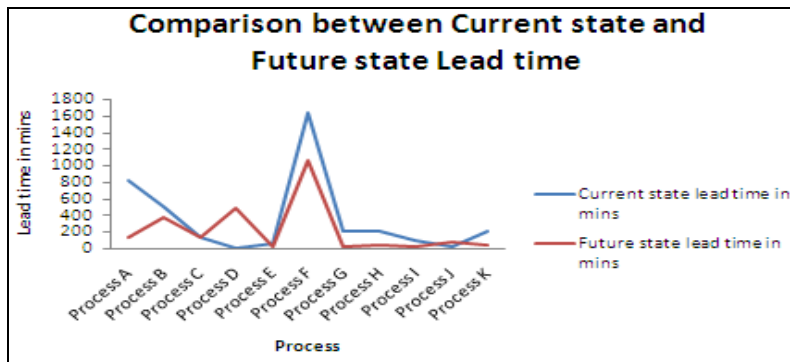


Figure 5: Comparison of Current state & Future state lead time

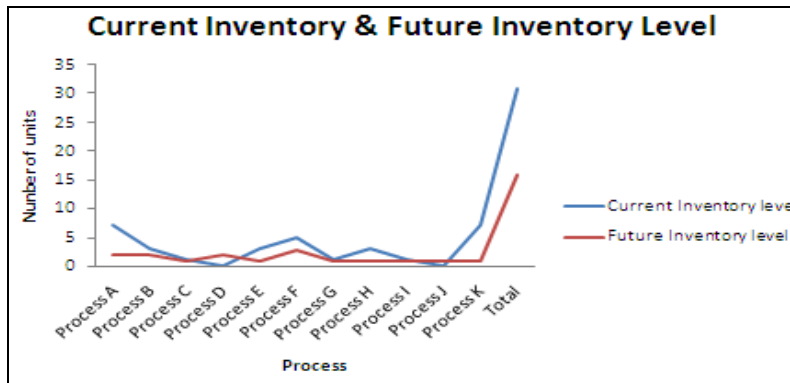


Figure 6: Comparison of Current state & Future state inventory

**7. Conclusion**

It is proven that VSM is a powerful tool in lean manufacturing which helps firms to understand and to improve continuously to work towards becoming lean enterprise .It connects people, process, tools and even documents required data to achieve lean goals. It delivers clear communication between shop floor teams and management regarding lean outlooks.

In this paper current state and future state is compared of a manufacturing firm and observed that reduction of 38.2 percent in lead time, process time reduction by 2.65percent, and 48.3 percent reduction in inventory.

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